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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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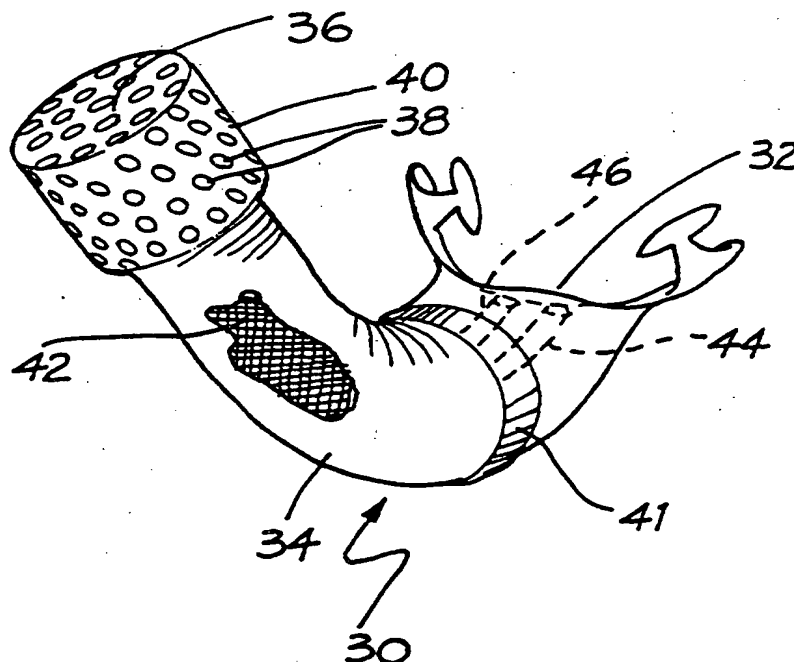
## Published

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(54) Title: A FILTERING DEVICE

## (57) Abstract

A filtering device (30) for use as a respirator, comprises a mouthpiece (32) that is shaped and arranged to be located in a person's mouth. A chamber (34) is formed integrally with the mouthpiece and is arranged to hold a filter (42). At least one opening (38) is provided within a wall of the chamber to permit air flow into and through the chamber, and a passageway (44) connects with the chamber and extends through the mouthpiece.



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A FILTERING DEVICE

## FIELD OF THE INVENTION

This invention relates to a filtering device, for example, portable and pocket-type filtering devices for filtering smoke, fumes, airborne particulate matter etc. The device may also be used to filter airborne pathogens for subsequent diagnosis. Whilst the device will be described primarily in these contexts, it should be appreciated that it has wider application.

## BACKGROUND ART

Conventional gas masks and respirators are often unwieldy and cumbersome apparatus which can be time-consuming to fit and uncomfortable during prolonged use. Furthermore, often only short-term use of an air filtering device is required and conventional gas masks can be generally inconvenient in such circumstances.

## SUMMARY OF INVENTION

The present invention provides a filtering device for use as a respirator and which comprises a mouthpiece that is shaped and arranged to be located in a person's mouth. A chamber is formed integrally with the mouthpiece and is arranged to hold a filter, and at least one opening is provided within a wall of the chamber to permit air flow into and through the chamber. A passageway connects with the chamber and extends through the mouthpiece to permit inhalation of filtered air.

The device has been developed primarily for use in circumstances where conventional gas masks may not be available or be convenient to wear. The device can readily lend itself to situations where short-term relief may be required from smoke or fume laden air. This may arise in situations where a person requires relief from an air entrained pollutant such as smoke or a noxious vapour whilst working in or escaping from a region containing the pollutant.

For example, the device can be used by firemen and fire victims to prevent smoke inhalation, by commuters and passengers in heavily polluted environments or where

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poisonous gas threat situations are imminent. The device can be used for taking samples for diagnosis in suspected contaminated areas. The device can also be used in workplace situations where noxious fumes or airborne particulate matter predominates.

To prevent a person using the device from inhaling through the nasal passages whilst inhaling filtered air through the device, it is preferred that means associated with the filtering device are provided for use in preventing or inhibiting nasal breathing.

These means may comprise a clamp device that is arranged to be placed on a user's nose to pinch the nares region of the nose. Such a clamp device may be used independently of the filtering device or be formed as an integral part of the filtering device. In the former case the clamp device may be moulded integrally with a portion of the filtering device and be removed for use as and when required.

In an alternative arrangement, the means arranged to inhibit nasal breathing may be formed as an integral extension of the filtering device and be shaped and positioned to abut the user's nose in a manner to block the nasal passages when the filtering device is held in the user's mouth. For this purpose the extension may be formed with a pad of soft material to abut the nose or be formed with projections that enter and block the nasal passages. The actual construction, shape and position of the nose blocking/pinching device is not critical, the only important requirement being that it should serve to inhibit nasal respiration whilst the user is inhaling through the mouthpiece.

By providing means associated with the filtering device for preventing or inhibiting nasal breathing, inhalation efficiency can be improved and inadvertent or involuntary intake of matter through the nose can also be prevented or substantially eliminated.

Where the filtering device is used for long periods of time or in emergency situations, it is preferred that

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the mouthpiece has a comfortable configuration. In this regard, it is preferred that the mouthpiece has a shape akin to the mouthpiece of a snorkel and/or diving respirator. The provision of such a mouthpiece can assist a user in stress release through a "biting-down" on the mouthpiece during use and can improve comfort.

The filter may comprise a replaceable composite filter, and the chamber is preferably located outside of the user's mouth. In one form the chamber is located in a tubular portion extending laterally (ie. to the side of the mouthpiece) in a swept-away configuration. Thus, the obtrusiveness of the filtering device can be minimised. A perforate cap can be fitted to the chamber that permits flow of ambient air through the filter and into the user's mouth during normal respiration.

The replaceable filter may also be in the form of a substrate for retaining airborne pathogens. The substrate can then be removed for subsequent diagnostic testing.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Notwithstanding any other forms which may fall within the scope of the present invention, preferred forms of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a plan view of one type of filtering device according to the invention;

Figure 2 shows a side elevation view of the device of Figure 1;

Figure 3 shows a front view of the device of Figure 1;

Figure 4 shows a side sectional elevation through the device of Figure 1;

Figure 5 shows a separate view of the nose clamp which can be moulded integrally with an end cap of the filtering device of Figure 1 but which is removable from the end cap;

Figure 6 shows a perspective view of another type of

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filtering device according to the invention;

Figure 7 shows an exploded perspective view of the device of Figure 6 illustrating the removal and replacement of filter cartridges for use in the filtering device;

Figure 8 shows a perspective schematic view of the device of Figure 6 in use;

Figure 9 shows a perspective underside view of the device of Figure 6 in a modified configuration;

Figure 10 shows a perspective underside view of the device of Figure 6 in a further modified configuration;

Figure 11 shows a schematic detail in side elevation of a modification of the device of Figure 10;

Figure 12 shows an underside perspective detail of the modified device of Figure 11;

Figure 13 shows a further embodiment of a filtering device according to the invention in side perspective detail; and

Figure 14 shows a front elevation of the device of Figure 13.

#### MODES FOR CARRYING OUT THE INVENTION

The filtering device as illustrated in the accompanying drawings 1 to 5 comprises a plastics material moulding 10 that incorporates a mouthpiece 11 and an integrally moulded chamber 12. The mouthpiece has a generally elliptical form in cross-section and is formed internally with a divided passageway 13. One portion of the passageway comprises an inhalation passage 13b and it extends between the chamber 12 and an open end region 14 of the mouthpiece. The other portion of the passageway 13 comprises an exhalation passage 13a and it extends from the open end region of the mouthpiece to exhaust ports 15.

The open end region of the mouthpiece is surrounded by a small flange 16 that may be located behind a user's teeth to prevent the device from slipping from the mouth of the user.

The chamber 12 has a generally cylindrical form and



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is arranged to receive a removable filter 17. A snap-on end cap 18 is fitted to the chamber for retaining the filter 17 and the end cap has a mesh-like central region 19 to permit air flow into and through the chamber 12. Air A is drawn through the end cap 18, through the filter 17 and along the inhalation passage 13<sub>b</sub> of the mouthpiece 11 during inhalation by the user. Exhausted air is directed through the exhalation passage 13<sub>a</sub> and it is exhausted through the outlet ports 15. Check valves 22 and 23 are provided in wall 24 to prevent inhaled air from being drawn through the exhaust ports 15 and, similarly, to prevent exhaled air from being exhausted through the filter 17.

Specifically, check valve 22 is a one-way valve which enables air to pass therethrough in the direction as indicated, but not in the opposite direction. Similarly, check valve 23 allows air to exit the device as stream E passing through the check valve in the direction indicated, but does not allow air to pass in the opposite direction.

Also, referring to Figure 4 it will be seen that filter 17 is in fact divided into three separate and removable filters, namely a particle filter 17a, an activated charcoal filter 17b, and a fine foam mesh-type filter 17c. This combination of filters provides an effective particulate matter filter as well as a fume and/or gas-type filtering medium.

Figure 4 also shows the employment of a whistle arrangement 16 which emits a whistle sound when air exits the device through passage 13a. This whistle arrangement enables a user of the device to alert others to the fact that a dangerous situation exists, without unnecessary removal of the device.

An open loop, generally elliptical, plastics material nose clamp 20 is moulded integrally with a surrounding flange 21 of the end cap 18 and the clamp may be broken away from the end cap as and when required, so that it may be sprung open and be positioned on a user's

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nose so as to close the nasal passages to inhibit nasal respiration.

Rather than employing a detachable nose clamp, a bridge and/or protrusions may be formed on the mouthpiece that project upwardly therefrom to engage either the nares region of a user's nose or protrude directly into the nostrils to block the same. This arrangement is shown schematically in Figure 2 wherein the bridge is denoted by the letter B and the optional nostril protrusion means by the letter N. Both components B and N can be formed from an appropriate padded material.

The clamp is employed to prevent nasal respiration during use of the filtering device and to encourage oral respiration, to prevent a user from inadvertently breathing noxious fumes that the filter 17 is intended to trap. The clamp can also be used with and arranged on the device of Figures 6 to 8.

Referring to Figure 6, a second type of filtering device comprises a moulded material 30 that incorporates a snorkel-type mouthpiece 32 and an integrally moulded filter column 34. The mouthpiece 32 is preferably formed from a soft polymer or elastomeric material for comfort and ease of fit. An intake head 36 is arranged at the opposing end of the filter column and incorporates a plurality of air inlets 38 opening onto a fibrous filter 40 arranged within the intake head. A second fibrous filter 41 is arranged at the opposing end of the filter column to enhance filter performance.

The filter column 34 typically has a granulated carbon filter 42 arranged therein, with a first passage 44 extending from the filter column and opening onto the mouthpiece. This passage enables air suction to be applied to the intake head via the filter column, so that air is drawn into the mouthpiece. Optionally, a second passage 46 adjacent to the first passage can be provided for air exhalation; valving arrangements similar to those shown in Figure 4 above can be employed with the first and second passages. Where a second passage is not

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employed, the user simply exhales back out through the filter device via the first passage.

The nose clamp 20 described above can also be employed with the device 30 and may be snap-fitted therearound. Alternatively, the nose clamp can be suspended from the device on an attachment string or line (not shown).

Figure 7 shows how a replaceable granular carbon filter cartridge 46 can be employed with the device 30 and demonstrates the ease of removal and replacement. The cartridge can employ an expiry indicator (eg. a chemically active colour change formulation) that indicates to a user when the cartridge is full and/or requires replacement.

The granular carbon filter cartridge can also include, or may be in the form of, a substrate that is capable of adsorbing and retaining thereon airborne pathogens. In certain applications, such as hospital environments and contaminated areas (including disease outbreak areas), the filtering device can be worn by a user to:

- (i) filter out these airborne pathogens; and
- (ii) retain them for subsequent diagnoses.

The filter cartridge can be removed and the substrate then tested to identify the pathogen types in the contaminated region.

Figure 8 shows a typical in-use configuration of the device 30 showing its compact and inobtrusive arrangement. It can be seen that air intake and exhalation is directed away from the user by the swept-back configuration of the device, pointing generally towards the user's ear.

Figure 9 shows a modification of the device of Figure 6 which is provided with an airflow exit and saliva release valve 48. This valve can be in the form of an opening which communicates with the first passage 44 to enable exhaled air to pass from the device via the valve. To prevent air intake via valve 48 during air

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suction through the device, a resilient flap 50 (eg. formed from a resilient and tacky polymeric material) is provided to cover the valve 48, and in effect functions as a one-way valve. However, other suitable one-way  
5 valve arrangements could equally be employed. In use, the resilient flap is biased to cover the valve 48, but is displaced away during exhalation through the device.

Referring to Figure 10, a further modification of the device 30 of Figure 6 is shown. In this case, an  
10 exit in saliva release valve 52 is provided on the end of a saliva collection chamber 54 formed integrally with the mouthpiece 32. A flexible membrane 56 can be provided over the valve 52, once again to function as a one-way valve (and again would be typically formed from a  
15 resilient and tacky polymeric material). The saliva collection chamber is in communication with the first passage (but both the valve 48 and valve 52 can also be in communication with the second passage 46, shown in Figure 6).

20 The shape of the collection chamber in Figures 7, 10 (and 11 and 12) is indicative only, and other suitable shapes such as curved or conical chambers could equally well be employed.

Referring to Figures 11 and 12, a modification on  
25 the device in Figure 10 is shown. Specifically, the saliva collection chamber can be formed as a detachable unit 58, with a plurality of exhaust ports 60 formed therein. As shown in Figure 12, the chamber 58 is detached to leave a release valve arrangement 52' similar  
30 to that shown in Figure 10. In the case of the embodiment of Figures 11 and 12, a flexible membrane (similar to membrane 56 in Figure 10) could be employed to act as a one-way valve.

Referring to Figures 13 and 14, a further  
35 modification of the filtering device is shown. The filtering medium 70 can be located in a helmet or cap 72. A communication conduit 74 extends from the filtering medium and is pivoted at pivot point 76. The

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continuation of the conduit 77 can be connected to a suitable mouthpiece (ie. as shown above in Figures 1 through 12), and the mouthpiece and conduit can be pivoted between a storage position, stored within the helmet (shown in dotted outline) and an in use engaged position (as shown in Figures 13 and 14). A nose piece 78 can be formed integrally with the mouthpiece and engage the nares region of a user's nose as shown.

The filtering medium can also be located in the visor or in other appropriate positions within the helmet. The filter as shown in Figures 13 and 14 can advantageously be employed in many work situations where immediate dust filtration protection is required, for example, by fire fighters, miners, building contractors, chemical plant operators etc.

Whilst the invention has been described with reference to a number of preferred embodiments it should be appreciated that the invention can be embodied in many other forms.

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CLAIMS

1. A filtering device for use as a respirator and which comprises a mouthpiece that is shaped and arranged to be located in a person's mouth, a chamber formed integrally with the mouthpiece and arranged to hold a filter, at least one opening within a wall of the chamber to permit air flow into and through the chamber, and a passageway connecting with the chamber and extending through the mouthpiece.
2. A filtering device as claimed in claim 1, that includes means associated with the filtering device arranged to prevent or inhibit nasal breathing by a person who is using the device.
3. A filtering device as claimed in claim 2, wherein the means for preventing or inhibiting nasal breathing is adapted for engaging the nostrils and/or the nares of the person using the device and is:
- (a) a nose clip adapted for detachable arrangement on the filtering device;
  - (b) integral projection(s) formed on the filtering device.
4. A filtering device as claimed in any one of the preceding claims, wherein the mouthpiece is in the form of a snorkel-type and/or diving respirator-type mouthpiece.
5. A filtering device as claimed in any one of the preceding claims, wherein the passageway includes a one-way valve arranged only to allow airflow into the person's mouth, and a second passageway having a one-way valve is also provided for enabling air outflow from the device.
6. A filtering device as claimed in claim 5 wherein the second passageway is in a parallel arrangement with said passageway and has a whistle means for producing a whistling sound when air is expelled therethrough.
7. A filtering device as claimed in claim 5 wherein the second passageway is arranged in or adjacent to the mouthpiece and has an associated saliva collection and/or

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release mechanism.

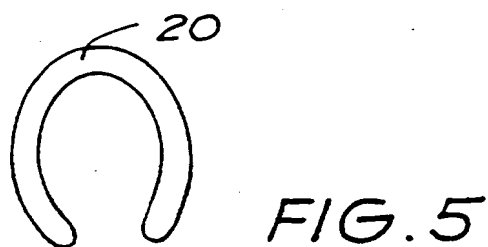
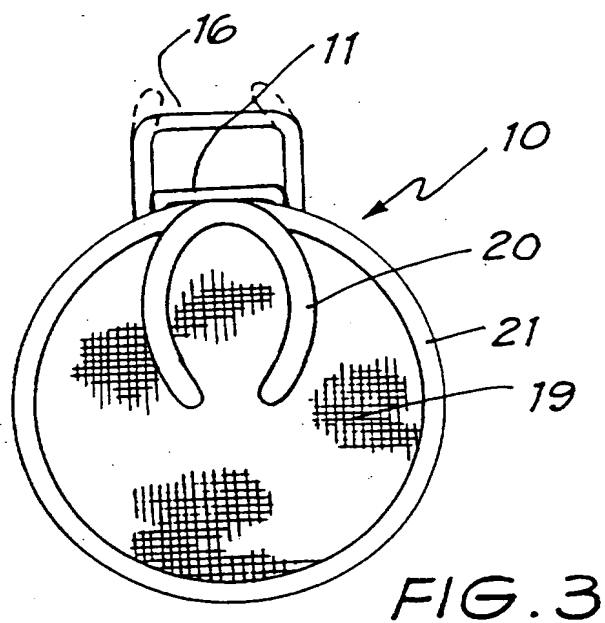
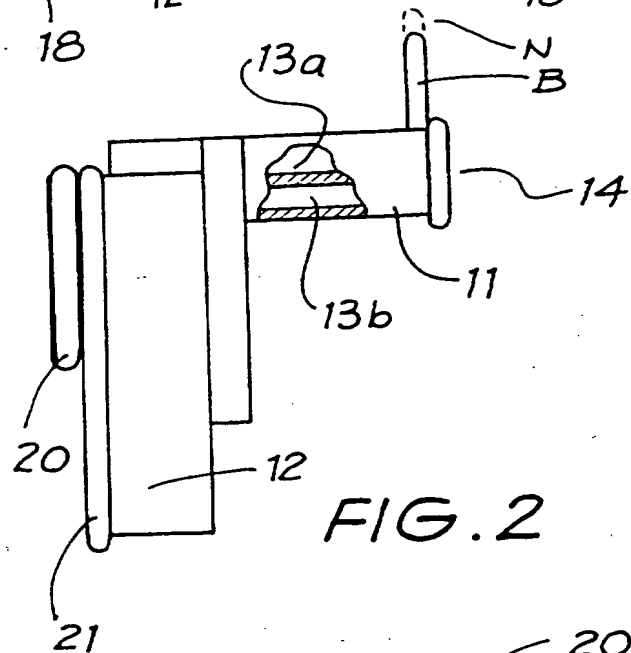
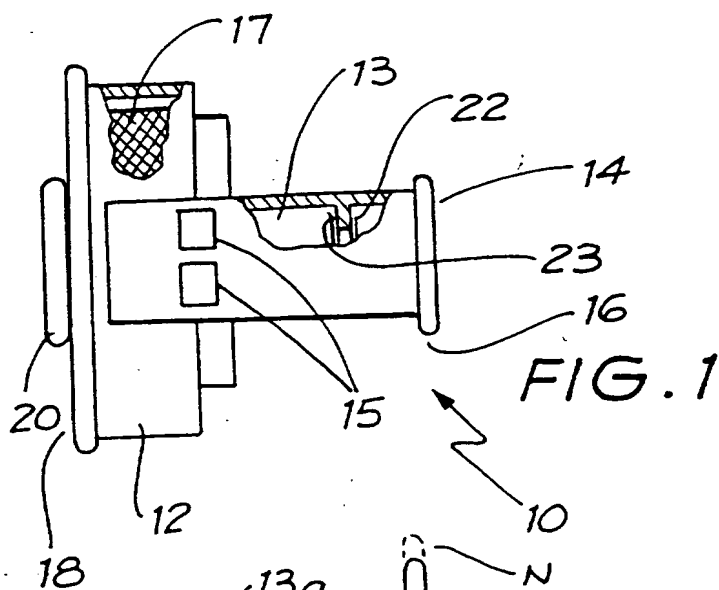
8. A filtering device as claimed in any one of the preceding claims wherein a replaceable composite filter is arranged in the chamber, and the chamber is in turn  
5 arranged in use to be located on the outside of the user's mouth.

9. A filtering device as claimed in claim 8 wherein the replaceable filter is adapted for retaining airborne pathogens thereon for subsequent diagnosis.

10 10. A filtering device as claimed in any one of the preceding claims wherein the chamber is located in a tubular portion that extends laterally away from the mouthpiece, and has a swept-away configuration to point generally towards a user's ear in use.

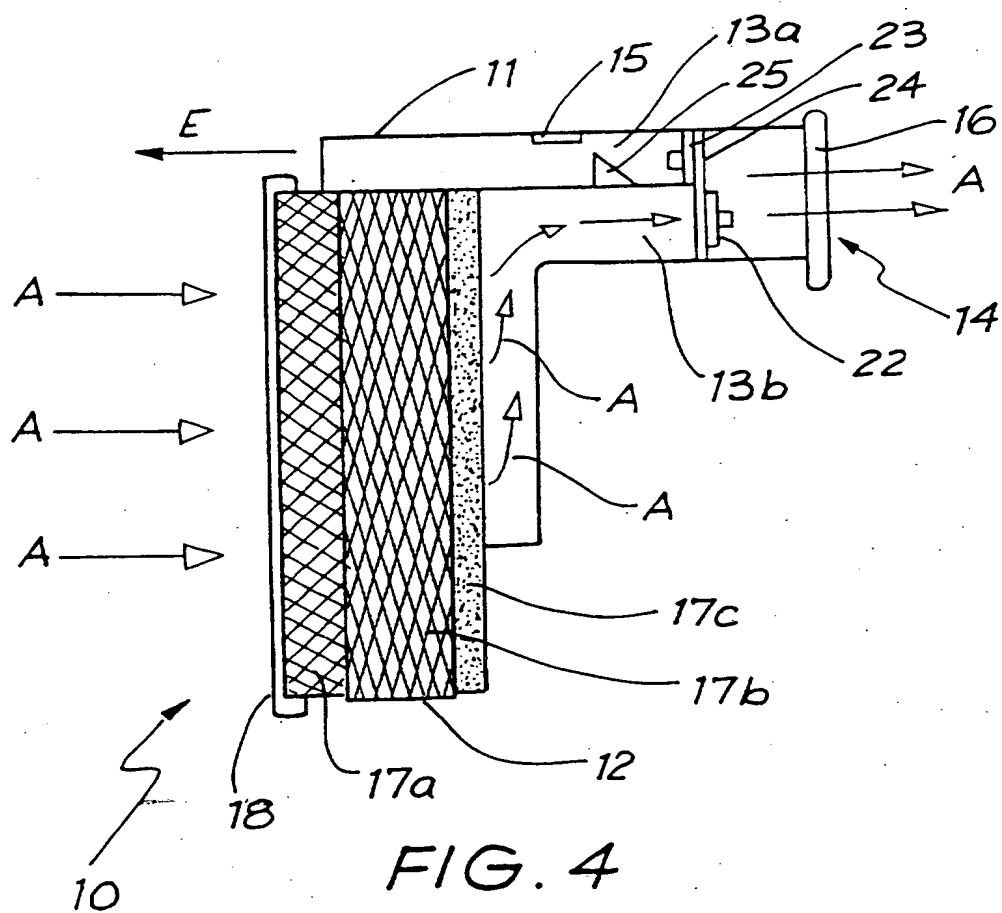
15 11. A filtering device as claimed in any one of the preceding claims wherein a perforate cap is fitted to a remote end of the chamber that is adapted to permit the flow of ambient air through the filter and into the user's mouth during normal respiration.

20 12. A filtering device as claimed in any one of the preceding claims, wherein the filter and chamber are located within a cap or helmet means worn on the head by a user, and are in fluid communication with the mouthpiece via a conduit.





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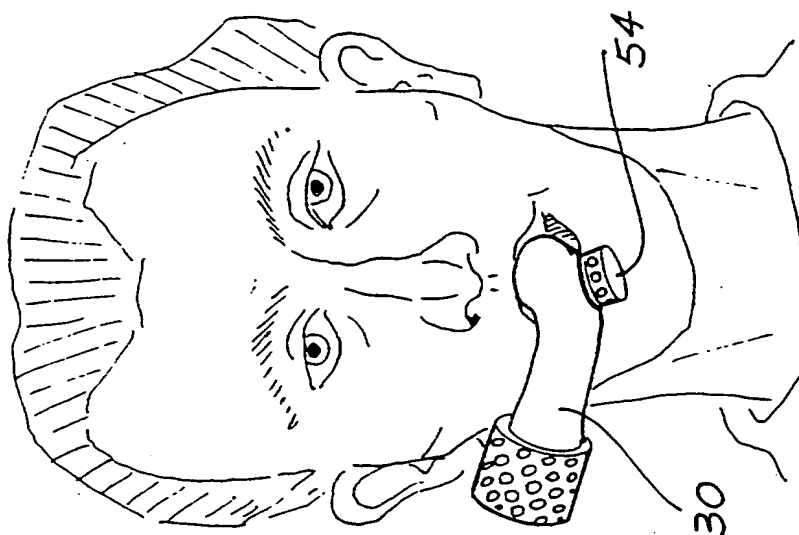


FIG. 8

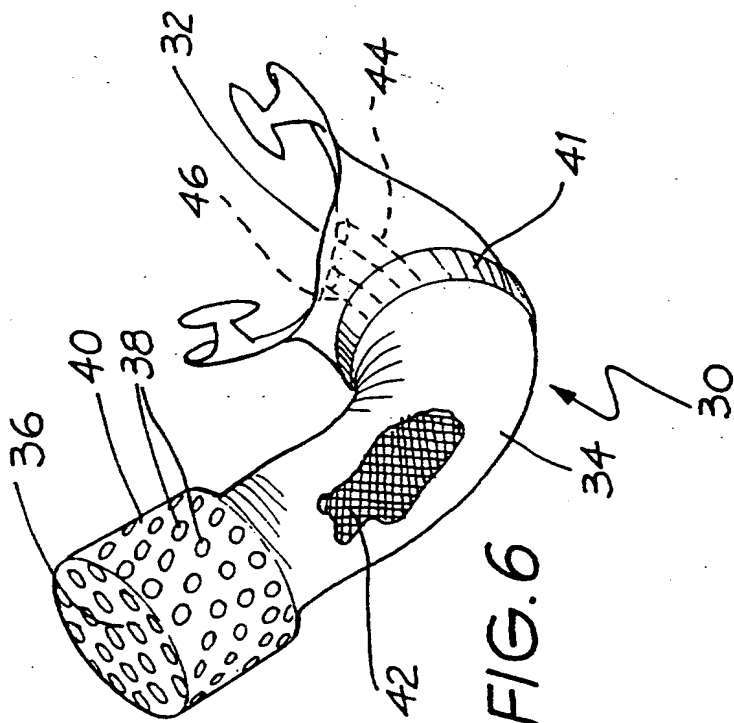


FIG. 6

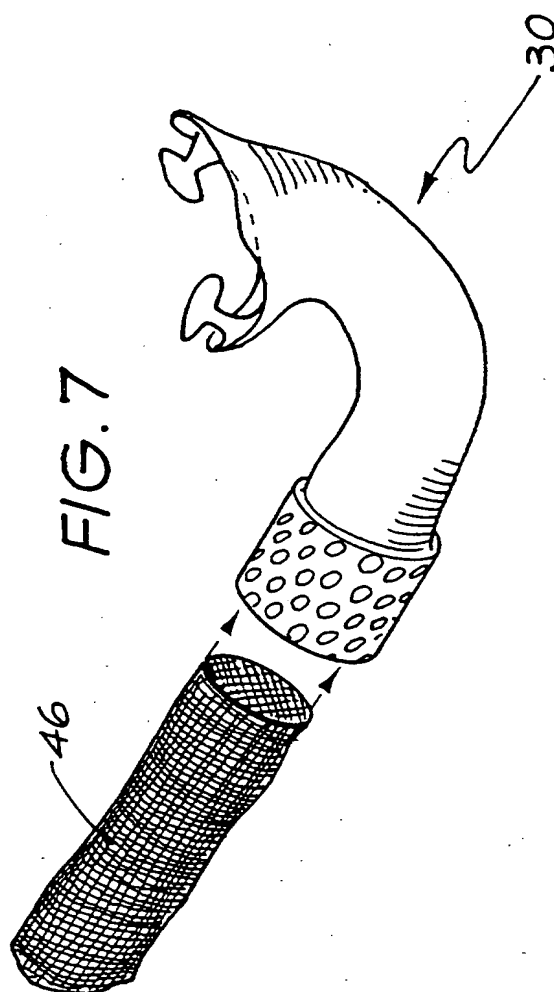
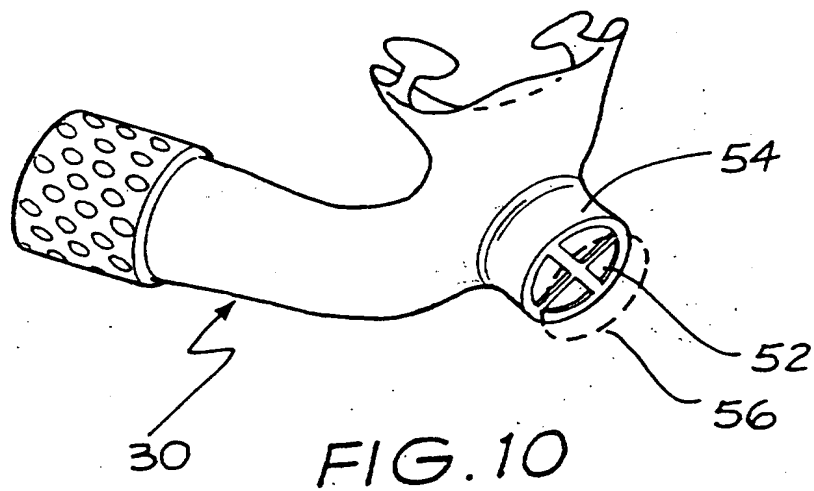
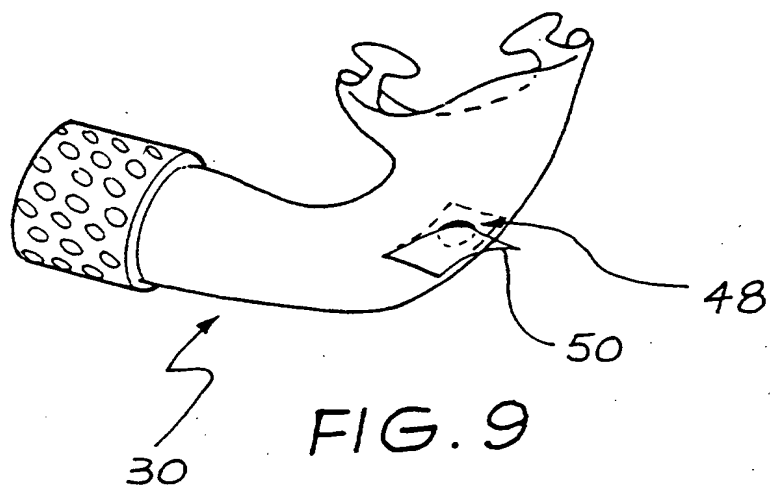


FIG. 7

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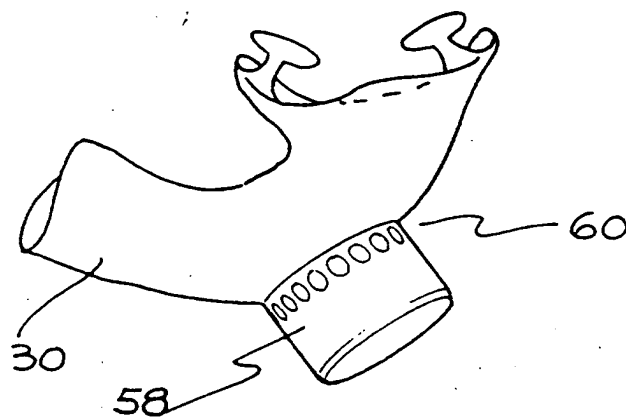


FIG. 11

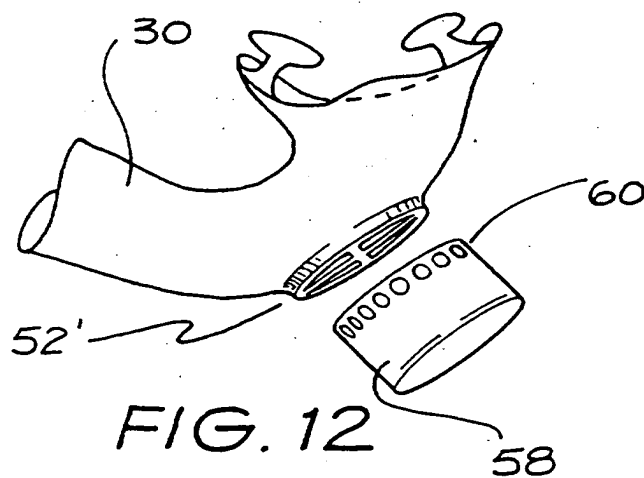
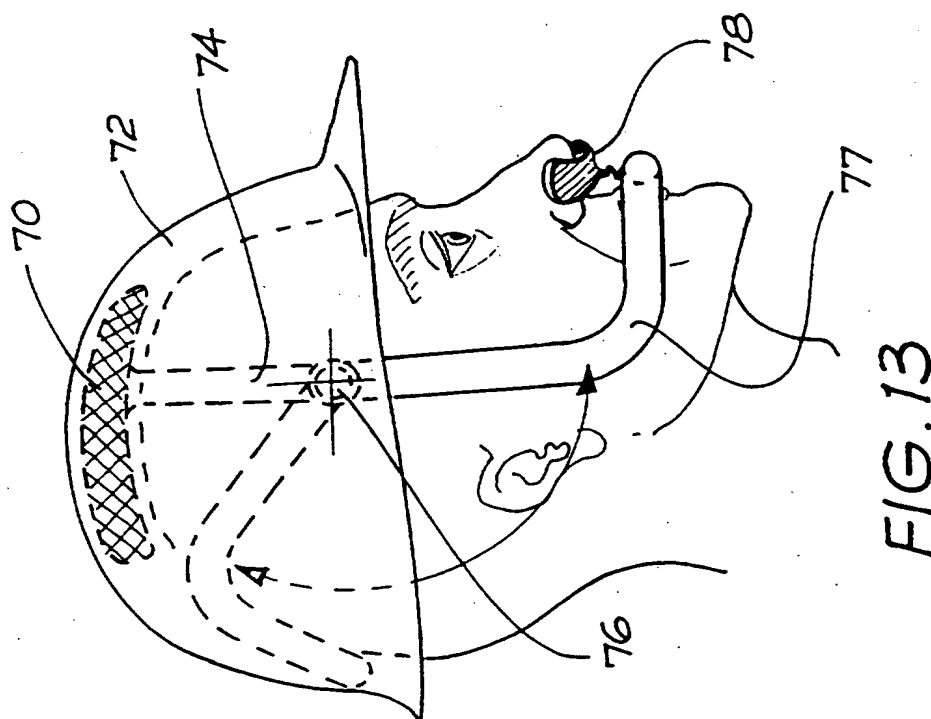
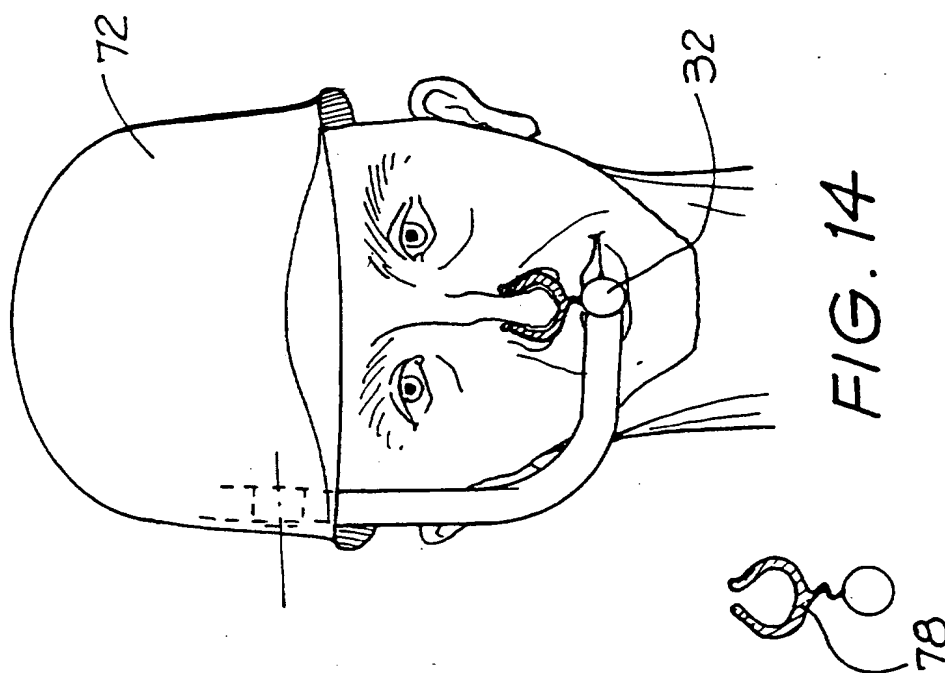


FIG. 12

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## INTERNATIONAL SEARCH REPORT

International Application No.  
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## A. CLASSIFICATION OF SUBJECT MATTER

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| X         | GB 2255285 A (LYNE) 4 November 1992<br>See whole document                          | 1, 2, 3               |
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| X  | US 4955373 A (MAGUIRE) 11 September 1990<br>See whole document                     | 1, 5                  |
| X  | US 4231364 A (SPESHYCOCK) 4 November 1980<br>See whole document                    | 1, 5                  |

# INTERNATIONAL SEARCH REPORT

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